REMARKS

Claims 1, 4-5, and 8-21 are all the claims presently pending in the application. Claims 9-15 have been withdrawn. Claims 1, 16, and 17 have been amended to more particularly define the invention. No new matter has been entered.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Entry of this § 1.116 Amendment is proper. Since the Amendments above narrow the issues for appeal and since such features and their distinctions over the prior art of record were discussed earlier, such amendments do not raise a new issue requiring a further search and/or consideration by the Examiner. As such, entry of this Amendment is believed proper and Applicant earnestly solicits entry.

Applicant appreciates the brief telephone interview on April 22, 2008, in which the undersigned attorney contacted the Examiner regarding page 5, fifth paragraph of the Office Action. Specifically, the undersigned attorney contacted the Examiner because the page of Ueda referenced by the Examiner, page 1361, was not included in the Ueda reference that the Examiner had included with the Office Action. The Examiner stated that page of Ueda referenced in the Office Action was incorrect. The Examiner further stated that the correct page of Ueda that should have been referenced in the Office Action was page 3561.

Claims 16-18 stand rejected under 35 U.S.C. § 102(b) as being allegedly anticipated by Harwig et al. ("Electrical Properties of β-Ga_2O_3 Single Crystals. II", Journal of Solid State Chemistry Vol. 23, pages 205-211, 15 January 1978).

Claims 1, 4, and 5 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Harwig in view of Ueda et al. ("Synthesis and Control of Conductivity of Ultraviolet Transmitting β-Ga_2O_3 Single Crystals", App. Phys. Lett. 70 (26), 30 June 1997). Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Harwig in view of Tamura et al. (U.S. Patent Publication No. 2004/0113156 A1). Claims 19-21 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Harwig.

The rejections mentioned above are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

An exemplary aspect of the claimed invention (e.g. as recited in claim 16) is directed to a method of controlling a conductivity of a Ga_2O_3 system single crystal that includes adding a predetermined dopant to the Ga_2O_3 system single crystal such that said dopant is substituted for Ga in the Ga_2O_3 system single crystal to obtain a desired conductivity. <u>The predetermined dopant includes a p-type dopant for controlling a conductivity of the Ga_2O_3 system single crystal, the p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, the conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of the p-type dopant</u>.

Conventional methods of controlling the conductivity of a Ga_2O_3 system single crystal have been used to control resistivity of the Ga_2O_3 system single crystal when a conductive property is required. Conventional methods, however, possess several different drawbacks. It is difficult using conventional methods to widely control the resisitivity because a substrate or thin film made of the Ga_2O_3 system single crystal naturally tends to have an n-type conductive property. It is also difficult using conventional methods to make a substrate or thin film of the Ga_2O_3 system single crystal

having a high insulating property despite the necessity of such a Ga_2O_3 system single crystal (Application at page 3, lines 8-21).

On the other hand, an exemplary aspect of the claimed invention includes a method of controlling a conductivity of a Ga_2O_3 system single crystal where the predetermined dopant includes a p-type dopant for controlling a conductivity of the Ga_2O_3 system single crystal, the p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, the conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of the p-type dopant (Application at page 13, lines 11-17; page 15, lines 13-19). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

II. THE RESTRICTION REQUIREMENT

The Examiner alleges that claims 9-13 and 14-15 are directed to inventions that are independent or distinct from the invention originally claimed. However, the Examiner has failed to allege facts sufficient to support this allegation, and therefore, the restriction requirement should be withdrawn.

The examiner must provide a clear and detailed record of the restriction requirement to provide a clear demarcation between restricted inventions so that it can be determined whether inventions claimed in a continuing application are consonant with the restriction requirement and therefore subject to the prohibition against double patenting rejections under 35 U.S.C. 121. (MPEP 814; *Geneva Pharms. Inc. v. GlaxoSmithKline PLC*, 349 F.3d 1373, 1381, 68 USPQ2d 1865, 1871 (Fed. Cir. 2003). See also MPEP § 804.01.

Applicant respectfully submits that the Examiner's burden with respect to the restriction requirements has not been satisfied, and, therefore, Applicant respectfully requests the Examiner to reconsider and withdraw the restriction requirement.

III. THE PRIOR ART REJECTIONS

A. The Harwig Reference

Harwig discloses the temperature dependence of the electronic contribution to the conductivity of doped Ga_2O_3 single crystals (Harwig at page 205). The Examiner alleges that Harwig anticipates the claimed invention, makes obvious the invention of claims 19-21, and teaches features of claims 1, 4, 5, 8.

<u>However</u>, Harwig <u>clearly</u> fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal "*<u>wherein said predetermined dopant comprises a p-type dopant for controlling the conductivity of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, said conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of said p-type dopant</u>*", as recited, for example, in claim 16 (Application at page 7, line 13 to page 8, line 2). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

The Examiner alleges that Harwig teaches a method for controlling a conductivity of a Ga_2O_3 system single crystal.

According to Harwig (page 205 at "2. Experimental"; lines 1-5 and page 206, lines 9-12), a purity of β-Ga_2O_3 powder is 4N. <u>This is lower than in the claimed invention</u>, where a purity of 6N is used.

Also according to Harwig (page 206, lines 4-9), "only a few hundred parts per million of Zr or Mg had actually been incorporated." In Harwig, there is no disclosure in which a conductivity is controlled depending on an adding amount of a dopant. Thus, a conductivity of β-Ga_2O_3 system single crystal might be affected by impurities of the β-Ga_2O_3 powders that exist in Harwig.

In addition, Harwig at page 206 and in Figure 1 only shows a temperature dependency of the conductivity of β-Ga_2O_3 system single crystal. Thus, Harwig does not teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

Further, according to Harwig, conductivity is not analyzed at room temperature. On the other hand, according to the claimed invention, the conductivity of Ga_2O_3 is analyzed at room temperature. Also in Harwig, a small change of the conductivity is observed at high temperature because of an influence of impurities. Thus, the conductivity in Harwig is not controlled by adding a dopant intentionally at room temperature.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw the rejection.

B. The Ueda Reference

To make up for the deficiencies of Harwig, the Examiner applies Ueda. Ueda discloses the doping of a β-Ga_2O_3 single crystal with Sn (Ueda at Abstract). The Examiner alleges that Ueda modifies Harwig to make the invention of claims 1, 4, and 5 obvious.

However, like Harwig, Ueda clearly fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal including "*wherein said predetermined dopant comprises one of an n-type dopant for controlling said conductivity of the Ga_2O_3 system single crystal comprising one of Si, Hf, Ge, Sn and Ti, said conductivity of the Ga_2O_3 system single crystal being controlled depending on an adding amount of said n-type dopant; and a p-type dopant for*

controlling the conductivity of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, said conductivity of the Ga_2O_3 system single crystal being controlled depending on an adding amount of said p-type dopant", as recited, for example, in claim 1 (Application at page 7, line 13 to page 8, line 2). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

According to Ueda on page 3561 (lines 6-8), a purity of β-Ga_2O_3 powder is 4N. This is lower than in the claimed invention, where a purity of 6N is used. It is not clear whether an expression of a conductivity of β-Ga_2O_3 system single crystal is due to doping of a dopant to the Ga_2O_3 powder or the expression of the conductivity of β-Ga_2O_3 system single crystal is due to the impurities of the Ga_2O_3 powder.

In addition, according to Ueda on page 3562, at Figure 1, the conductivity of Ga_2O_3 is controlled by changing the growth atmosphere, which is clearly contrary to the claimed invention. Also, only one conductivity of Sn-doped Ga_2O_3 is shown by Ueda. Thus, Ueda clearly fails to teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

Further, according to Ueda, a change in conductivity is observed by the difference of the density of oxygen. Specifically, Ueda teaches that Sn doping does not improve conductivity, which teaches against the claimed invention.

Thus, even assuming (arguendo) Harwig and Ueda would have been combined by one of ordinary skill in the art, the resultant combination fails to teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant. Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

C. The Tamura Reference

To make up for the deficiencies of Harwig, the Examiner applies Tamura. Tamura discloses a semiconductor light emitting device (Tamura at Abstract). The Examiner alleges that Tamura modifies Harwig to make obvious the invention of claim 8.

However, like Harwig, Tamura clearly fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal including "*wherein said predetermined dopant comprises one of an n-type dopant for controlling said conductivity of the Ga_2O_3 system single crystal comprising one of Si, Hf, Ge, Sn and Ti, said conductivity of the Ga_2O_3 system single crystal being controlled depending on an adding amount of said n-type dopant; and a p-type dopant for controlling the conductivity of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, said conductivity of the Ga_2O_3 system single crystal being controlled depending on an adding amount of said p-type dopant*", as recited, for example, in claim 1 (Application at page 13, lines 11-17; page 15, lines 13-19). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

According to Tamura on page 12 (claims 3, 10, 18, and 26), the crystallinity of gallium oxide is not shown. The object of dopant with an impurity to gallium oxide is for decreasing the sheet resistance. Thus, Tamura clearly fails to teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant, and even assuming (arguendo) combination with Harwig, clearly fails to make up for the deficiencies of Harwig detailed in Section A.

In addition, Applicant respectfully disputes the Examiner's characterization of what Tamura teaches. The Examiner alleges that paragraphs 98 and 99 of Tamura teach "the numerical value of

the resistivity for adding p-type dopant" (Office Action at page 6, third paragraph). However, a numerical value is not contained in either paragraph. Tamura simply suggests in these paragraphs that second semiconductor layer in Tamura possesses "small resistance". Applicant respectfully submits that the "small resistance" of Tamura is not substantive enough to teach or suggest "wherein 1×10^3 Ωcm or more is obtained as the desired resistivity by adding a predetermined amount of said p-type dopant", as recited, for example, in claim 8.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1, 4-5, and 8-21, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: May 27, 2008

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